THE AQUATIC PLANT COMMUNITY IN EASTON LAKE, ADAMS COUNTY, WISCONSIN OCTOBER 2006

Submitted by Reesa Evans
Adams County Land & Water Conservation Department

P.O. Box 287, Friendship, WI 53934

608-339-4268

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ADAMS COUNTY 2006

I. INTRODUCTION

An aquatic macrophytes (plants) field study in Easton Lake was conducted during August 2006 by a staff member the Adams County Land and Water Conservatism Department and a member of the Easton Lake District Board.

Information about the diversity, density and distribution of aquatic plants is an essential component in understanding the lake ecosystem due to the integral ecological role of aquatic vegetation in the lake and the ability of vegetation to impact water quality (Dennison et al, 1993). This study will provide information useful for effective management of Easton Lake, including fish habitat improvement, protection of sensitive areas, aquatic plant management, and water resource regulation. This baseline data will provide information that can be used for comparison to future information and offer insight into changes in the lake.

Ecological Role: Lake plant life is the beginning of the lake's food chain, the foundation for all other lake life. Aquatic plants and algae provide food and oxygen for fish and wildlife, as well as cover and food for the invertebrates that many aquatic organisms depend on. Plants provide habitat and protective cover for aquatic animals. They also improve water quality, protect shorelines and lake bottoms, add to the aesthetic quality of the lake, and impact recreation.

Characterization of Water Quality: Aquatic plants can serve as indicators of water quality because of their sensitivity to water quality parameters such as clarity and nutrient levels (Dennison et al, 1993).

Easton Lake readings for hardness and pH score its water as "hard" to "very hard", with the pH running over 8.00. Such lakes tend to produce more fish and aquatic plants than soft water lakes.

Background and History: Easton Lake is located in the Town of Easton, Adams County, Wisconsin. The impoundment is 24 surface acres in size. Maximum depth is 11', with an average depth of 5'. During the summer of 2006 when this aquatic plant survey was conducted, the lake was at slightly lower level than usual due to drought and very hot weather.

There is a public boat ramp located on the north side of the lake owned by the Adams County Parks Department.

Easton Lake is easily accessible off of County Road A, not far off of State Highway 13. Residential development around the lake is most concentrated along the north and south lakeshores. The surface watershed is 11 % residential, 16.6% non-irrigated agriculture, 17.5% irrigated agriculture, 48.2% woodlands .3% open grasslands and 6.4% water. The ground watershed contains 23.21%% irrigated agriculture, 17.97% non-irrigated agriculture, 43.71% woodlands, 15.45% residential, .36% open grasslands and 3.47% water. There are no known endangered or threatened species in or around the lake.

Fish inventories dating back to 1954 show that panfish are abundant to common, depending on the species. Bullheads, northern pike, trout and bass tend to be scarce. Stocking from 1937 to 1944 consisted entirely of bullheads of various ages.

Soils directly around Easton Lake tend to be sands or loamy sands, except directly around the lake, where silt loam is found. Such soils tend to be well-drained or excessively-drained, with infiltration of water being rapid to very rapid, and permeability also high. Such soils also usually have a low water-holding and low organic matter content, thus making them difficult to establish vegetation on. These soils tend to be easily eroded by both water and wind.

The Easton Lake District has been working on controlling aquatic plant growth by machine harvesting since 2002. In 2002, 140,000 pounds of aquatic plant growth were harvested from the lake. Machine harvesting removed 116,000 pounds of aquatic plants in 2003. In 2004, 212,000 pounds were harvested. Machine harvesting in 2005 removed 140,000 pounds of aquatic plant growth from the lake. Machine harvesting continued in 2006, but information about the pounds of aquatic plants removed is not yet available.

II. METHODS

Field Methods

The study was based on the rake-sampling method developed by Jessen and Lound (1962), using stratified random transects. The shoreline was divided into 12 equal sections, with one transect placed randomly within each segment, perpendicular to the shoreline.

One sampling site was randomly chosen in each depth zone (0-1.5'; 1.5'-5'; 5'-10'; 10'-20') along each transect. Using long-handled, steel thatching rakes, four rake samples were taken at each site. Samples were taken from each quarter around the boat. Aquatic species present on each rake were recorded and given a density rating of 0-5.

A rating of 1 indicates the species was present on 1 rake sample.

A rating of 2 indicates the species was present on 2 rake samples.

A rating of 3 indicates the species was present on 3 rake samples.

A rating of 4 indicates the species was present on 4 rake samples.

A rating of 5 indicates that the species was abundantly present on all rake samples.

A visual inspection and periodic samples were taken between transects to record the presence of any species that didn't occur at the raking sites. Gleason and Cronquist (1991) nomenclature was used in recording plants found.

Shoreline type was also recorded at each transect. Visual inspection was made of 50' to the right and left of the boat along the shoreline, 35' back from the shore (so total view was 100’ x 35’). Percent of land use within this rectangle was visually estimated and recorded.

Data Analysis:

The percent frequency (number of sampling sites at which it occurred/total number of sampling sites) of each species was calculated. (See Appendix A) Relative frequency (number of species occurrences/total all species occurrences) was also determined. (See Appendix A) The mean density (sum of species’ density rating/number of sampling sites) was calculated for each species. (See Appendix B) Relative density (sum of species’ density/total plant density) was also determined. (See Appendix B) Mean density where present (sum of species’ density rating/number of sampling sites at which species occurred) was calculated. (See Appendix B) Relative frequency and relative density results were summed to obtain a dominance value. (See Appendix C) Species diversity was measured by Simpson’s Diversity Index. (See Appendix A)

The Average Coefficient of Conservatism and Floristic Quality Index were calculated as outlined by Nichols (1998) to measure plant community disturbance. A coefficient of Conservatism is an assigned value between 0 and 10 that measures the probability that the species will occur in an undisturbed habitat. The Average Coefficient of Conservatismism is the mean of the coefficients for the species found in the lake. The coefficient of conservatism is used to calculate the Floristic Quality Index, a measure of a plant community’s closeness to an undisturbed condition.

An Aquatic Macrophyte Index was determined using the method developed by Nichols et al (2000). This measurement looks at the following seven parameters and assigns each of them a number on a scale of 1-10: maximum depth of plant growth; percentage of littoral zone vegetated; Simpson's diversity index; relative frequency of submersed species; relative frequency of sensitive species; taxa number; and relative frequency of exotic species. The average total for the North Central Hardwoods lakes and impoundments is between 48 and 57.

III. RESULTS

Physical Data

The aquatic plant community can be impacted by several physical parameters. Water quality, including nutrients, algae and clarity, influence the plant community; the plant community in turn can modify these boundaries. Lake morphology, sediment composition and shoreline use also affect the plant community.

The trophic state of a lake is a classification of water quality (see Table 1). Phosphorus concentration, chlorophyll a concentration and water clarity data are collected and combined to determine a trophic state. **Eutrophic lakes** are very productive, with high nutrient levels and large biomass presence. **Oligotrophic lakes** are those low in nutrients with limited plant growth and small fisheries. **Mesotrophic lakes** are those in between, i.e., those which have increased production over oligotrophic lakes, but less than eutrophic lakes; those with more biomass than oligotrophic lakes, but less than eutrophic lakes; those with a good and more varied fishery than either the eutrophic or oligotrophic lakes.

The limiting factor in most Wisconsin lakes, including Easton Lake, is phosphorus. Measuring the phosphorus in a lake system thus provides an indication of the nutrient level in a lake. Increased phosphorus in a lake will feed algal blooms and also may cause excess plant growth. **The 2004-2006 summer average phosphorus concentration in Easton Lake was 49.08 ug/l.** This is below the average for impoundments lakes. This concentration suggests that Easton Lake is likely to have some nuisance algal blooms, but not as frequently as many impoundments. This places Easton Lake in the "fair" water quality section for lakes, but in the "eutrophic" level for phosphorus.

Chlorophyll concentrations provide a measurement of the amount of algae in a lake's water. Algae are natural and essential in lakes, but high algal populations can increase water turbidity and reduce light available for plant growth. **The 2004-2006 summer average chlorophyll concentration in Easton Lake was 41.52 ug/l.** This places Easton Lake at the "eutrophic" level for chlorophyll a results.

Water clarity is a critical factor for plants. If plants receive less than 2% of the surface illumination, they won't survive. Water clarity can be reduced by turbidity (suspended materials such as algae and silt) and dissolved organic chemicals that color or cloud the water. Water clarity is measured with a Secchi disk. **Average summer Secchi disk clarity in Easton Lake in 2004-2006 was 7.96'.** This is good clarity, putting Easton Lake into the "mesotrophic" category for water clarity.

It is normal for all of these values to fluctuate during a growing season. They can be affected by human use of the lake, by summer temperature variations, by algae growth & turbidity, and by rain or wind events. Phosphorus tends to rise in early summer, than decline as late summer and fall progress. Chlorophyll a tends to rise in level as the water warms, then decline as autumn cools the water. Water clarity also tends to decrease as summer progresses, probably due to algae growth, then increase as fall approaches.

Table 1: Trophic States

Trophic State	Quality Index	Phosphorus (ug/l)	Chlorophyll a (ug/l)	Sechhi Disk (ft)
Oligotrophic	Excellent	<1	<1	>19
	Very Good	1 to 10	1 to 5	8 to 19
Mesotrophic	Good	10 to 30	5 to 10	**6 to 8**
	Fair	**30 to 50**	10 to 15	5 to 6
Eutrophic	Poor	50 to 150	**15 to 30**	3 to 4
Easton Lake		**49.08**	**41.52**	**7.96**

According to these results, Easton Lake scores as **"mesotrophic"** in its phosphorus & water quality readings, but **"eutrophic"** in its chlorophyll a readings. With such high phosphorus readings and high chlorophyll a readings, dense plant growth and frequent algal blooms would be expected, but the lake continues to have "good" to "very good" water clarity.

Lake morphology is an important factor in distribution of lake plants. Duarte & Kalff (1986) determined that the slope of a littoral zone could explain 72% of the observed variability in the growth of submerged plants. Gentle slopes support higher plant growth than steep slopes (Engel 1985).

Easton Lake is a narrow, shallow lake fed by a very large stream system. Most of the lake is shallow, although there are a couple of areas of steeper slopes within the lake near the dam. With such good water clarity, plant growth may be favored in Easton Lake since the sun can get to most of the sediment to stimulate plant growth.

Sediment composition can also affect plant growth, especially those rooted. The richness or sterility and texture of the sediment will determine the type and abundance of macrophyte species that can survive in a particular lake (see Table 2 and Appendix A).

Table 2: Sediment Composition—Easton Lake

Sediment	Type	0-1.5'	1.5'-5'	5'-10'	10'-20'	All Sites
Hard	Sand	7.14%	7.14%	44.44%	100.00%	18.42%
	Sand/Brick	7.14%				2.63%
Mixed	Sand/Silt	14.29%	7.14%			7.90%
	Sand/Muck	7.14%				2.63%
Soft	Silt/Muck		7.14%			2.63%
	Muck	50.00%	42.86%	55.56%		34.21%
	Silt	14.29%	35.72%			31.58%

Over 68% of the sediment in Easton Lake is soft with natural fertility and significant available water holding capacity. Although sand sediment may limit growth, all sandy sites in Easton Lake were vegetated. In fact, all sample sites were vegetated in Easton Lake, no matter what the sediment (see Appendix G). This suggests factors other than sediment are more important in determining aquatic plant growth in Easton Lake.

Shoreline land use often strongly impacts the aquatic plant community and thus the entire aquatic community. Impacts can be caused by increased erosion and sedimentation and higher run-off of nutrients, fertilizers and toxins applied to the land. Such impacts occur in both rural and residential settings.

Native wooded vegetation was the shoreline cover of the highest mean coverage of 41.43% (see Table 3). But disturbed sites, such as those with traditional lawn, rock/riprap, hard structures and pavement, were also frequent, covering nearly 21% of the shoreline (20.72%). Bare unprotected soil was found (1.07%).

Table 3: Shoreland Land Use—Easton Lake

Cover Type		Occurrence frequency at transects	Percent Coverage
Vegetated	Wooded	92.86%	41.43%
Shoreline	Herbaceous	57.14%	24.64%
	Shrubs	57.14%	11.79%
Disturbed	Cultivated Lawn	35.71%	16.79%
Shoreline	Hard Structures	21.43%	1.79%
	Rock/riprap/pavement	21.42%	2.49%
	Bare Soil	14.29%	1.07%

Some type of vegetated shoreline was found at 100% of the sites and covered 77.86% of the lake shoreline.

Macrophyte Data

SPECIES PRESENT

Of the 21 species found in Easton Lake, 18 were native and 3 were exotic invasives. In the native plant category, 8 were emergent, 3 were free-floating plants, and 7 were submergent types (see Table 4). Three exotic invasives, *Myriophyllum spicatum* (Eurasian Watermilfoil), *Phalaris arundinacea* (Reed Canarygrass) and *Potamogeton crispus* (Curly-Leaf Pondweed) were found.

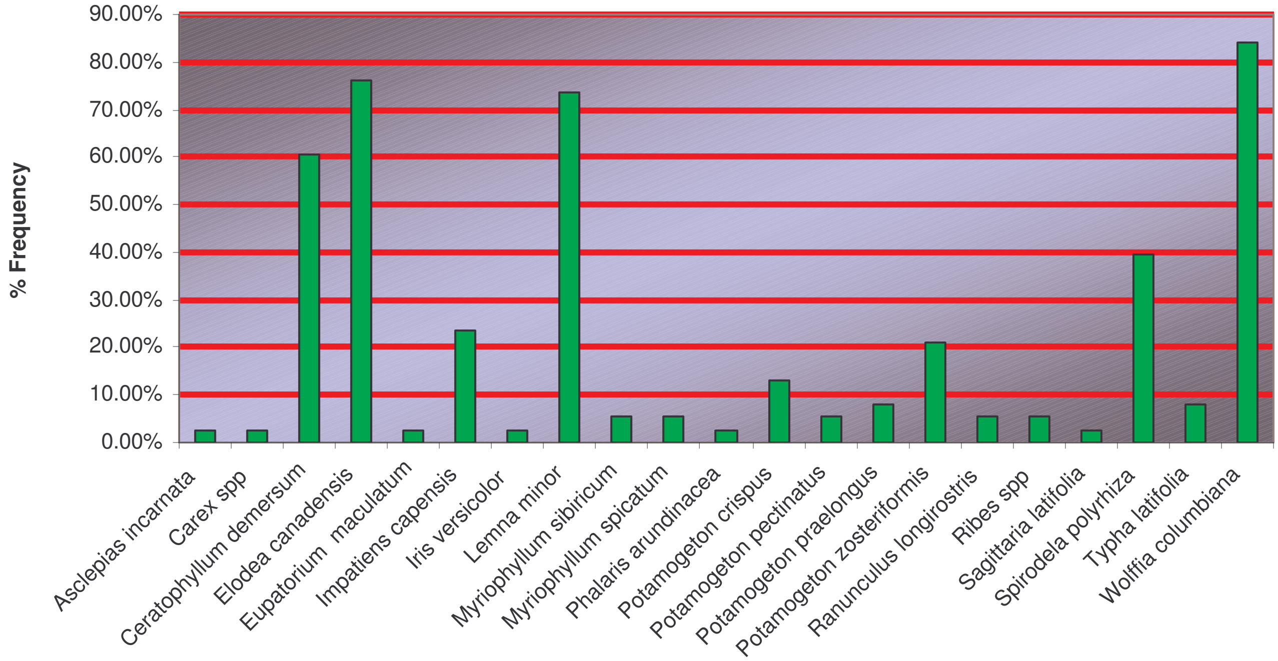
Table 4—Plants Found in Easton Lake, 2006

Scientific Name	Common Name	Type
Asclepias incarnata	Swamp Milkweed	Emergent
Carex spp	Sedges	Emergent
Ceratophyllum demersum	Coontail	Submergent
Elodea canadensis	Common Waterweed	Submergent
Eupatorium maculatum	Joe-Pye-Weed	Emergent
Impatiens capensis	Jewelweed	Emergent
Iris versicolor	Blue-Flag Iris	Emergent
Lemna minor	Small Duckweed	Floating
Myriophyllum sibiricum	Northern Milfoil	Submergent
Myriophyllum spicatum	Eurasian Watermilfoil	Submergent
Phalaris arundinacea	Reed Canarygrass	Emergent
Potamogeton crispus	Curly-Leaf Pondweed	Submergent
Potamogeton pectinatus	Sage Pondweed	Submergent
Potamogeton praelongus	White-Stem Pondweed	Submergent
Potamogeton zosteriformis	Flat-Stem Pondweed	Submergent
Ranunculus longirostris	Water Buttercup	Submergent
Ribes spp	Currant	Emergent
Sagittaria latifolia	Duck Potato	Emergent
Spirodela polyrhiza	Large Duckweed	Floating
Typha latifolia	Wide-Leaf Cattail	Emergent
Wolffia columbiana	Watermeal	Floating

FREQUENCY OF OCCURRENCE

Wolffia columbiana was the most frequently-occurring plant in Easton Lake in 2006 (84.21% frequency), followed by *Elodea* canadensis (76.32%), *Lemna minor* (73.68%) and *Ceratophyllum demersum* (60.53%). No other species reached a frequency of 50% or greater.

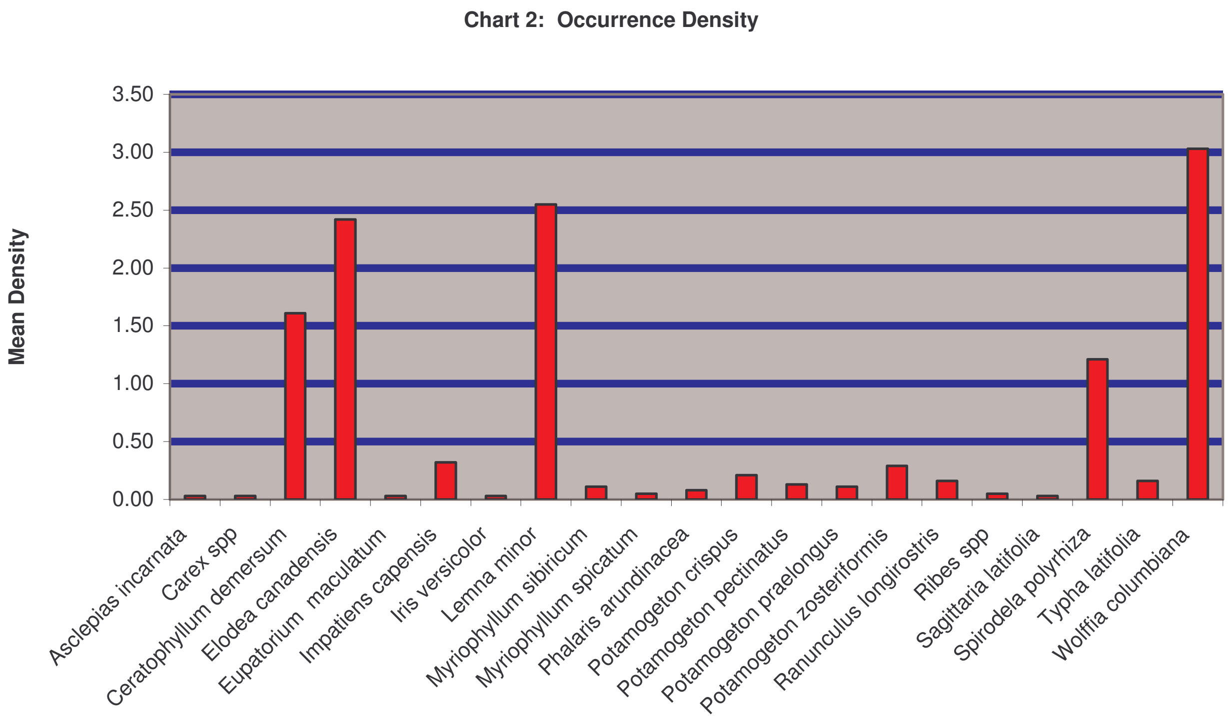
Chart 1: Occurrence Frequency



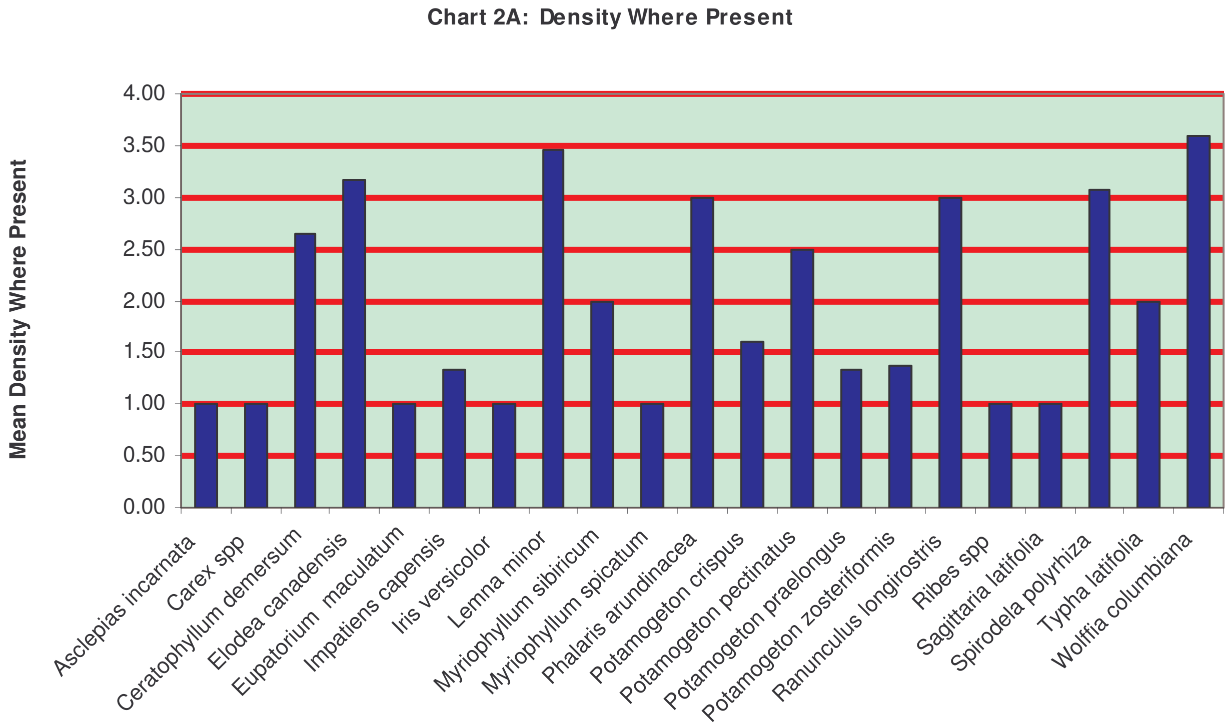
Filamentous algae was found at 100% of the sample sites.

DENSITY OF OCCURRENCE

Wolffia columbiana was the densest plant in Easton Lake, with a mean density of 3.03. *Elodea canadensis* (2.42) and *Lemna minor* (2.55) also had mean densities over 2.0. These plants occurred at more than average density overall in the lake in summer 2006. *Wolffia columbiana* (3.21) and *Lemna minor* (2.71) occurred at more than average density in 0-1.5' depth zone. *Elodea canadensis* (2.86), *Lemna minor* (2.79) and *Wolffia columbiana* (2.93) occurred at more than average density in the 1.5'-5' depth zone. In the 5'-10' depth zone, *Ceratophyllum demersum* (2.22), *Elodea canadensis* (3.56), *Lemna minor* (2.22) and *Wolffia columbiana* (3.00) all occurred at more than average density. Depth Zone 4 (10'-20') had all of four of these at more than average densities of 4.00, 4.00, 2.00 and 2.00 respectively.



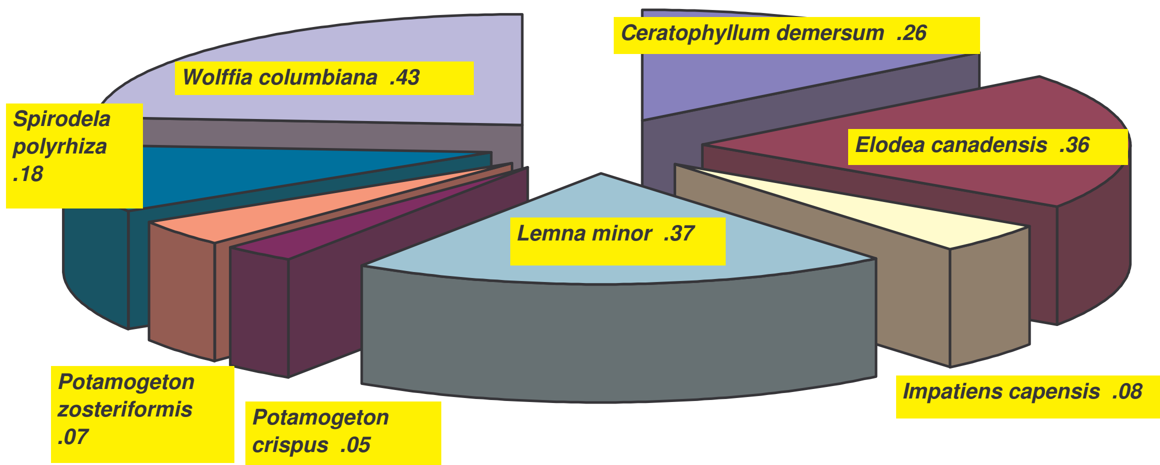
The situation is different when density where present is examined. There are more species that have more than average density where present: *Certatophyllum demersum; Elodea canadensis; Lemna minor; Phalaris arundinacea* (exotic invasive); *Potamogeton pectinatus; Ranunculus longirostris; Spirdola polyrhiza; Wolffia columbiana.*



DOMINANCE

Relative frequency and relative density are combined into a dominance value that demonstrates how dominant a species is within its aquatic plant community. Based on dominance value, *Wolffia columbiana* was the dominant aquatic plant species in Easton Lake. Sub-dominant were *Lemna minor, Elodea canadensis*, and *Certatophyllum demersum,* in that order. *Myriophyllum spicatum, Potamogeton crispus* and *Phalaris arundinacea*, the exotics found Easton Lake, were not present in high frequency, high density or high dominance. It is possible that *Potamogeton crispus* is under-represented, since this survey was performed in August, somewhat later than its peak season.

Chart 3: Dominance



Wolffia columbiana was dominant in Depth Zone 1, with *Lemna minor* sub-dominant. *Elodea canadensis* dominated Depth Zone 2, with *Lemna minor* and *Wolffia columbiana* sub-dominant. *Wolffia Columbiana* was dominant in Depth Zone 3; *Elodea canadensis* and *Lemna minor* were sub-dominant. *Ceratophyllum demersum* and *Elodea canadensis* dominated Depth Zone 4.

DISTRIBUTION

Aquatic plants occurred at 100% of the sample sites in Easton Lake to a maximum rooting depth of 11'. Free-floating plants were found in all four depth zones (see Appendix B).

Chart 4: Macrophyte Frequency

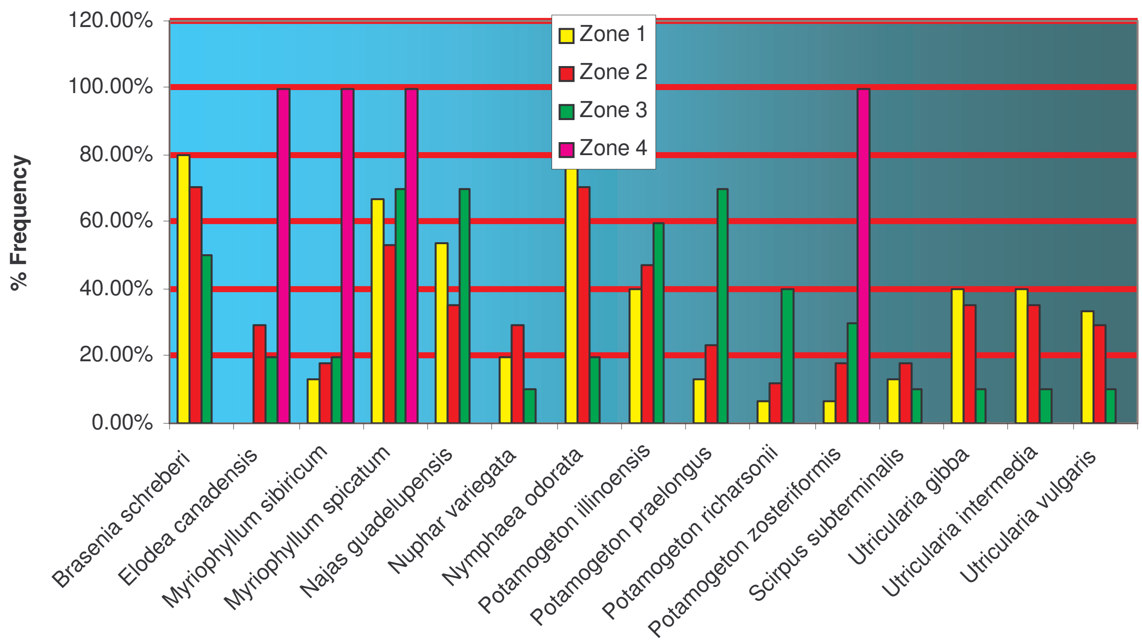
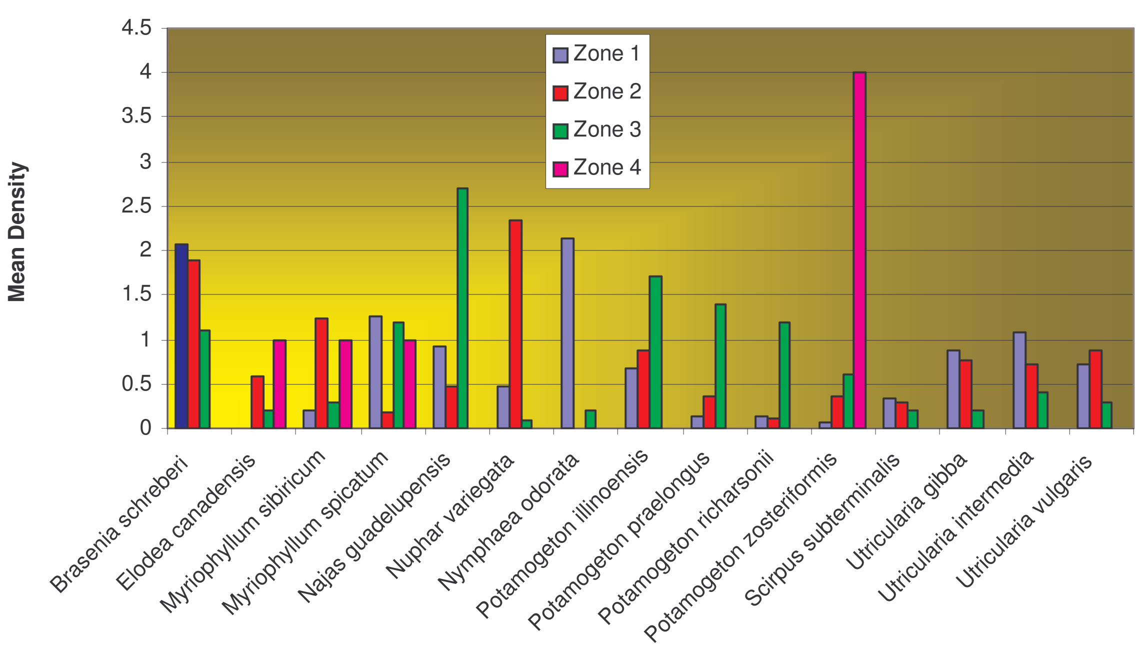


Chart 5: Macrophyte Density



Secchi disc readings are used to predict maximum rooting depth for plants in a lake (Dunst, 1982). Based on the summer 2004-2006 Secchi disc readings, the predicted maximum rooting depth in Easton Lake would be **12.44 feet** (deeper than the deepest portion of the lake)**.** During the 2006 aquatic plant survey, rooted plants were found at a depth of **11'**, i.e., rooted plants were at a depth be expected by Dunst calculations.

The 0-1.5' depth zone (Zone 1) produced the most frequently occurring plant growth, followed by Zone 2 (1.5'-5'), then Zone 3 (5'-10'), and finally, Zone 4 (over 10'). The same order was followed with aquatic plant density. Both frequency and density then dropped off at depths over 5', although plants were still found in those depths.

Chart 6: Zone Frequency

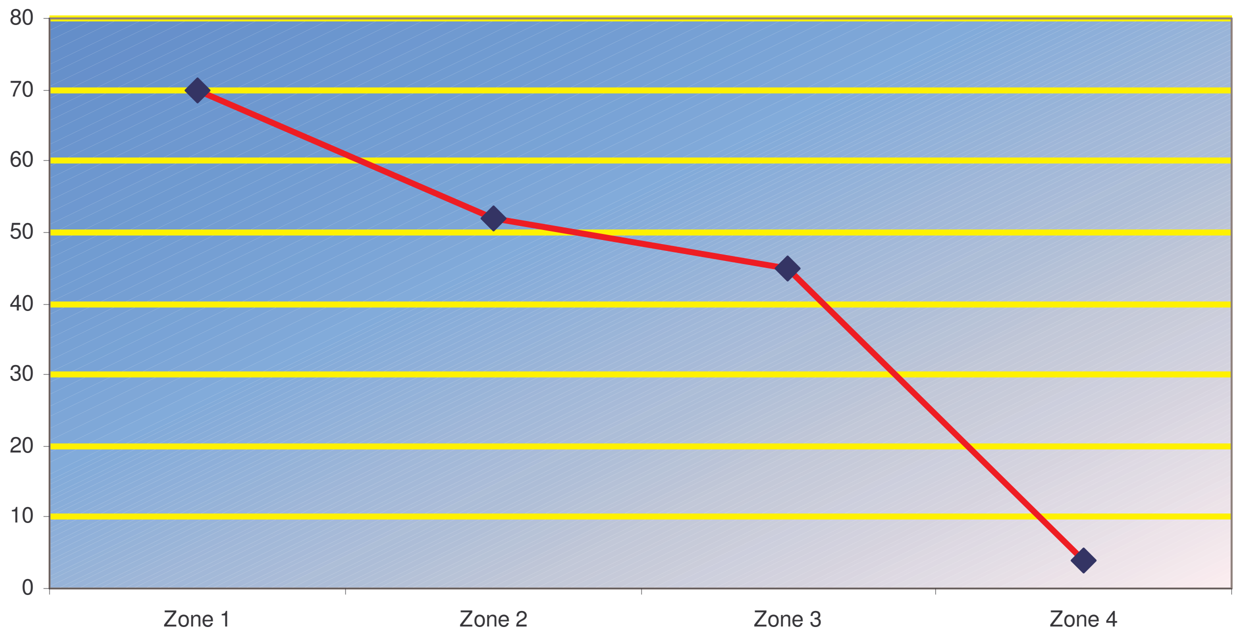
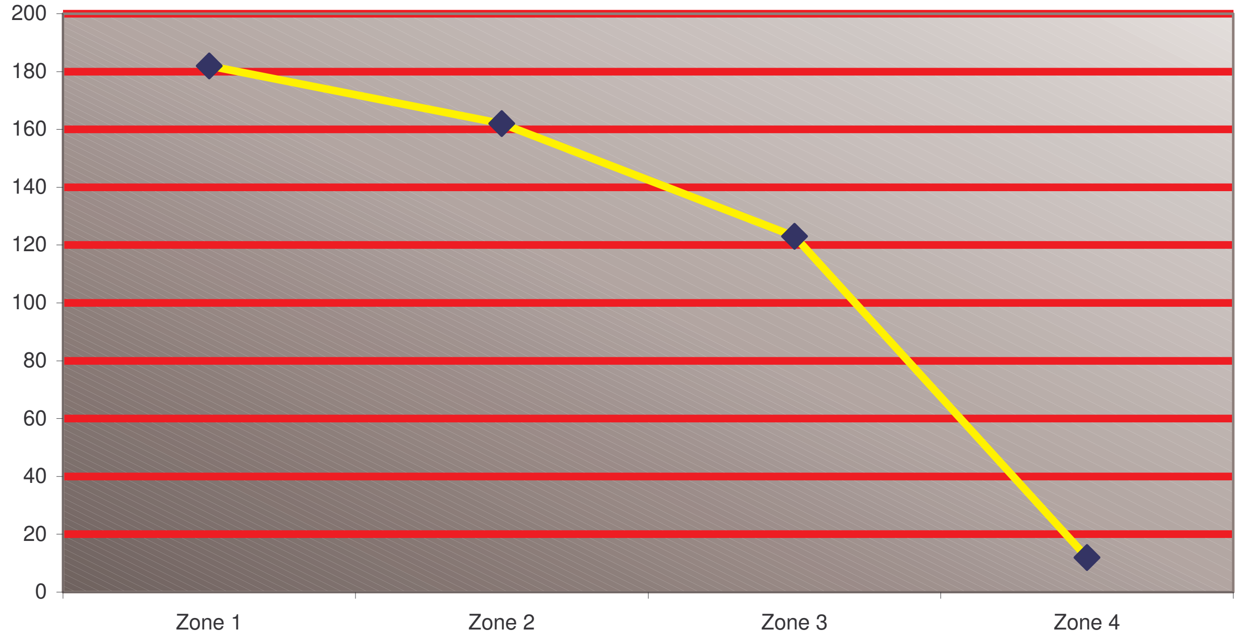


Chart 7: Zone Density



The greatest number of species per site (species richness) was found in Zone 1 and Zone 3, each with 5.0 richness score. Zone 3 had the lowest species richness (4.9), followed closely by Zone 4 (5.0). Zone 4 had a species richness of 4.0, with Zone 2 had a species richness of 3.71. Overall species richness was 4.5.

THE COMMUNITY

The Simpson's Diversity Index Easton Lake was .88, suggesting fair species diversity. A rating of 1.0 would mean that each plant in the lake was a different species (the most diversity achievable). This places it in the average range for Simpson's Diversity Index readings for both North Central Hardwood Forest and Wisconsin Lakes overall. The Aquatic Macrophyte Community Index (AMCI) for Easton Lake is 49. This is in the average range for North Central Wisconsin Hardwood Lakes and all Wisconsin lakes.

Table 5: Aquatic Macrophyte Community Index

Aquatic Macrophyte Community Index for Easton Lake 2006		
Category	Easton Lake results	Value
Maximum rooting depth	11’	6
% littoral area vegetated	100%	10
%submersed plants	62%	8
% sensitive plants	5%	5
# taxa found	19 (3 exotic)	6
exotic species frequency	5%	6
Simpon's Diversity	.88	8
total		**49**

The presence of several invasive, exotic species could be a significant factor in the future. Currently, none of the exotic species appear to be taking over the aquatic plant community, perhaps due to the high density and occurrence of other native plants such as *Elodea canadensis. Myriophyllum spicatum* (Eurasian watermilfoil) should be monitored, since its tenacity and ability to spread to large areas fairly quickly could make it a danger to the diversity of Easton Lake’s current aquatic plant community.

A Coefficient of Conservatism and a Floristic Index calculation were performed on the field results. Technically, the average Coefficient of Conservatism measures the community’s sensitivity to disturbance, while the Floristic Index measures the community’s closeness to an undisturbed condition. Indirectly, they measure past and/or current disturbance to the particular community.

Previously, a value was assigned to all plants known in Wisconsin to categorize their probability of occurring in an undisturbed habitat. This value is called the plant’s Coefficient of Conservatism. A score of 0 indicates a native or alien opportunistic invasive plant. Plants with a value of 1 to 3 are widespread native plants. Values of 4 to 6 describe native plants found most commonly in early successional ecosystem. Plants scoring 6 to 8 are native plants found in stable climax conditions. Finally, plants with a value of 9 or 10 are native plants found in areas of high quality and are often endangered or threatened. In other words, the lower the numerical value a plant has, the more likely it is to be found in disturbed areas.

The Average Coefficient of Conservatism Easton Lake was 3.68. This puts it in the lowest quartile for Wisconsin Lakes (6.0) and for lakes in the North Central Hardwood Region (5.6). The aquatic plant community in Easton Lake is in the category of those very tolerant of disturbance, probably due to selection by a series of past disturbances.

The Floristic Quality Index of the aquatic plant community in Easton Lake of 16.06 is below average for Wisconsin Lakes (22.2) and the North Central Hardwood Region (20.9). This is a further indication that the plant community in Easton Lake is farther from an undisturbed condition than the average lake in Wisconsin overall and in the North Central Hardwood Region. In other words, the aquatic plant community in Easton Lake been impacted by an above average amount of disturbance and tolerates higher than average disturbance.

“Disturbance” is a term that covers many disruptions to a natural community. It includes physical disturbances to plant beds such as boat traffic, plant harvesting, chemical treatments, dock and other structure placements, shoreline development and fluctuating water levels. Indirect disturbances like sedimentation, erosion, increased algal growth, and other water quality impacts will also negatively affect an aquatic plant community. Biological disturbances such as the introduction of non-native and/or invasive species (such as the Eurasian Watermilfoil, Reed Canarygrass and Curly-Leaf Pondweed found here), destruction of plant beds, or changes in aquatic wildlife can also negatively impact an aquatic plant community. Shore development and sediment deposition can also reduce the quality of the aquatic plant community.

Some of the sample transects had an entirely native shore, although more sites was had shore disturbed by humans.

	Natural	**Disturbed**
Number of species	15	18
FQI	14.98	15.08
Average Coef. Of Cons	3.87	3.56
Simpson's Index	0.87	0.88
Filamentous algae	100%	100%

Analyzing transects at natural shore vs. disturbed shore indicated little difference between the disturbed and natural shores for FQI, Average Coefficient of Conservatism and Simpson's Index of Diversity. All shores also had filamentous algae. The high amount of disturbance probably explains this lack of differentiation between natural and disturbed shores.

IV. DISCUSSION

Based on water clarity, chlorophyll and phosphorus data, Easton Lake is an eutrophic to mesotrophic seepage lake with fair to good water clarity and fair water quality. This trophic state should support fairly dense plant growth and frequent algal blooms.

Sufficient nutrients (trophic state), good water clarity, shallow lake, and soft sediments at Easton Lake favor plant growth. Despite the sometime limiting effect of sand sediments on aquatic plant growth, 100% of the lake is vegetated, suggesting that even the sand sediments in Easton Lake hold sufficient nutrients to maintain aquatic plant growth.

Some mechanical harvesting of aquatic plants in Easton Lake has been occurring, but without a regular schedule or pattern. There appear to have been no recent chemical treatments to try to reduce plant growth. A regular schedule and pattern of machine harvesting and spot-treating the exotics could help in control vegetation in navigation areas and may somewhat help with nutrient reduction. The harvesting should also be designed to set back the growth of Eurasian Watermilfoil, not spread it further. It might also help to skim off the high density of filamentous algae and floating-leaf plants.

The lake does have a mixture of emergent, floating and rooted plants. Of the 21 species found in Easton Lake, 18 were native and 3 were exotic invasives. In the native plant category, 9 were emergent, 3 were free-floating plants, and 9 were submergent types. Three exotic invasives, *Myriophyllum spicatum* (Eurasian Watermilfoil), *Phalaris arundinacea* (Reed Canarygrass) and *Potamogeton crispus* (Curly-Leaf Pondweed) were found.

Wolffia columbiana was the densest plant in Easton Lake, with a mean density of 3.03. *Elodea canadensis* (2.42) and *Lemna minor* (2.55) also had mean densities over 2.0. These plants occurred at more than average density overall in the lake in summer 2006. *Wolffia columbiana* (3.21) and *Lemna minor* (2.71) occurred at more than average density in Depth Zone 1 (0-1.5'). *Elodea canadensis* (2.86), *Lemna minor* (2.79) and *Wolffia columbiana* (2.93) occurred at more than average density in Depth Zone 2 (1.5'-5'). In Depth Zone 3 (5'-10'), *Ceratophyllum demersum* (2.22), *Elodea canadensis* (3.56), *Lemna minor* (2.22) and *Wolffia columbiana* (3.00) all occurred at more than average density. Depth Zone 4 had all of four of these at more than average densities of 4.00, 4.00, 2.00 and 2.00 respectively.

The situation is different when density where present is examined. There are more species that have more than average density where present: *Ceratophyllum demersum; Elodea canadensis; Lemna minor; Phalaris arundinacea* (exotic invasive); *Potamogeton pectinatus; Ranunculus longirostris; Spirdola polyrhiza; Wolffia columbiana..*

The most developed shore—that along the northside of the lake—has many "grandfathered" buildings that are close to the shore, suggesting that runoff from impervious surfaces such as decks or rooftops could be adding to the pollutant load in the lake. Installation of as much buffer (native) vegetation as possible between the buildings and the ordinary high water mark could filter pollutants and nutrients and help keep them out of the lake water.

Along the south shore, there is a large parking lot, County Road A and a supper club all very close to the lake, creating significant stormwater runoff and soil erosion potential. Installation of runoff diversion practices and some shore protection here would help protect water quality. There are areas of wooded and wetland shores on the southeast part of the lake that should be preserved as they are to maintain habitat and to serve as a buffer for that area. Studies have suggested that runoff from establish wooded land is substantially less than that of developed areas.

The Simpson's Diversity Index for Easton Lake was .88, suggesting fair species diversity. The Aquatic Macrophyte Community Index (AMCI) Easton Lake is 49 (see Table 6), in the average range for Central Wisconsin Hardwood Lakes. The Average Coefficient of Conservatism score puts Eason Lake is in the category of those very tolerant of disturbance. The Floristic Quality Index of the aquatic plant community in Easton Lake of 16.06 is below average for Wisconsin Lakes and lakes in the North Central Hardwood Region. This indicates that the plant community in Easton Lake is among the group of lakes farther to an undisturbed condition than the average state or regional lake.

Some kind of native vegetation was the dominant shore cover in Easton Lake (total of 77.86%). However, disturbed sites, such as those with cultivated lawn, hard structure, rock/riprap and pavement, were also common, with coverage of over 20%. Of vegetated shorelines, wooded vegetation had the most coverage (41.43%). Some type of disturbed shoreline was found at over 71% of the sites. These conditions offer little protection for water quality and have significant potential to negatively impact Easton Lake's water by increased runoff (including lawn fertilizers, pet waste, pesticides) and shore erosion. Expanding the amount of vegetation and/or runoff catch at these shorelines would help prevent erosion and reduce runoff into the lake that contributes to algal growth, increased sedimentation, and reduced water quality.

An aquatic plant community evaluation was conducted on Easton Lake in 2001. Comparing the results of the two evaluations, there are some changes in the aquatic plant community. Improvement seems at first evident in a higher Simpson's Diversity Index, higher Floristic Quality Index, higher AMCI score, higher species richness, and more species found. However, the average Coefficient of Conservatism has gone down, suggesting that even though there may be more species present, they are of types that tolerate more disturbance in the aquatic ecosystem, rather than high-quality plants. Further, the invasive *Myriophyllum spicatum* was not previously found in Easton Lake.

Further, when calculating the coefficient of similarity between the 2001 and 2006 surveys, they score as statistically similar. Based on frequency of occurrence, the aquatic plant communities of the two years are 76% similar. Based on relative frequency, they are 73% similar. Similarity percentages of 75% are considered statistically similar.

Easton	2001	2006	Change	%Change
Number of Species	12	21	9	75.0%
Maximum Rooting Depth	9.0	11.0	2	22.2%
% of Littoral Zone Unvegetated	0	0	0	0.0%
%Sites/Emergents	10.53%	13.16%	0.0	25.0%
%Sites/Free-floating	68.42%	86.84%	0.2	26.9%
%Sites/Submergents	94.74%	84.21%	-0.1	-11.1%
%Sites/Floating-leaf	0.00%	0.00%	0.0	0.0%
Simpson's Diversity Index	0.82	0.88	0.06	7.3%
Species Richness	3.63	4.50	0.87	24.0%
Floristic Quality	15.01	16.06	1.05	7.0%
Average Coefficient of Conservatism	4.33	3.68	-0.65	-15.0%
AMCI Index	43	49	6.00	14.0%

The most noticeable change between 2001 and 2006 is the addition of several emergent plants to the aquatic plant community. *Asclepias incarnate, Carex spp, Eupatorium maculatum, Impatiens capensis, Iris versicolor, Ribes spp,* and *Sagittaria latifolia* were not first identified as present in the 2006 survey. *Typha latifolia*, also an emergent plant, decreased in frequency of occurrence, as did *Ranunculus longirostris.*

Another change was the increased presence of free-floating plants: *Lemna minor* increased from 68.42% frequency to one of 73.66%; *Wolffia columbiana* went from 63.16% to 84.21%; and *Spirodela polyrhiza*, not found in 2001, had a frequency of 39.47%.

Of submergent plants, both *Ceratophyllum demersum* and *Elodea canadensis* decreased in frequency of occurrence. *Potamogeton pusillus* and *Vallisneria americana*, found in 2001, were not found in 2006. *Potamogeton praelongus*, a more sensitive plant than *P. pusillus* and *V. Americana*, was found at Easton Lake for the first time in 2006. *Potamogeton zosteriformis* increased in frequency. Two submergent plants, *Myriophyllum sibiricum* and *Potamogeton pectinatus*, remained the same in frequency.

Unfortunately, another change is that two invasive exotics, *Myriophyllum spicatum* and *Phalaris arundinacea* were found in 2006 and had not been previously reported in Easton Lake. Further, the frequency of another exotic, *Potamogeton crispus*, increased from 5.26% *to* 13.16%*,* even though the 2006 survey was conducted after peak season for that plant.

V. CONCLUSIONS

Easton Lake is an eutrophic to mesotrophic lake with fair to good water quality and water clarity. The quality of the aquatic plant community in Easton Lake is below average for Wisconsin lakes and for lakes in the North Central Hardwood region, as measured by Floristic Quality Index, AMCI, and Coefficient of Conservatism. Filamentous algae was common. Structurally, it contains emergent plants, free-floating plants, and submergents, although no floating-leaf rooted plants.

When the aquatic plant survey was performed in 2006, 100% of the littoral zone was vegetated. The potential for plant growth at all depths of the lake is present, even though a few of the lake sediments are sandy. This growth percent is over the recommended vegetation percentage for best fishing (50%-85%).

Wolffia columbiana was the most frequently-occurring plant in Easton Lake in 2006 (84.21% frequency), followed by *Elodea* canadensis (76.32%), *Lemna minor* (73.68%) and *Ceratophyllum demersum* (60.53%). No other species reached a frequency of 50% or greater.

Wolffia columbiana was also the densest plant overall in Easton Lake, with a mean density of 3.03. *Elodea canadensis* (2.42) and *Lemna minor* (2.55) also had mean densities over 2.0. These plants therefor occurred at more than average density overall in the lake in summer 2006. *Wolffia columbiana* (3.21) and *Lemna minor* (2.71) occurred at more than average density in Depth Zone 1 (0-1.5’). *Elodea canadensis* (2.86), *Lemna minor* (2.79) and *Wolffia columbiana* (2.93) occurred at more than average density in Depth Zone 2 (1.5’-5’). In Depth Zone 3

(5'-10'), *Ceratophyllum demersum* (2.22), *Elodea canadensis* (3.56), *Lemna minor* (2.22) and *Wolffia columbiana* (3.00) all occurred at more than average density. Depth Zone 4 had all of four of these at more than average densities of 4.00, 4.00, 2.00 and 2.00 respectively.

A healthy and diverse aquatic plant community plays a vital role within the lake ecosystem. Plants help improve water quality by trapping nutrients, debris and pollutants in the water body; by absorbing and/or breaking down some pollutants; by reducing shore erosion by decreasing wave action and stabilizing shorelines and lake bottoms; and by tying-up nutrients that would otherwise be available for algae blooms. Aquatic plants provide valuable habitat resources for fish and wildlife, often being the base level for the multi-level food chain in the lake ecosystem, and also produce oxygen needed by animals.

Further, a healthy and diverse aquatic plant community can better resist the invasion of species (native and non-native) that might otherwise "take over" and create a lower quality aquatic plant community. A well-established and diverse plant community of natives can help check the growth of more tolerant (and less desirable) plants that would otherwise crowd out some of the more sensitive species, thus reducing diversity.

Vegetated lake bottoms support larger and more diverse invertebrate populations that in turn support larger and more diverse fish and wildlife populations (Engel, 1985). Also, a mixed stand of aquatic macrophytes (plants) supports 3 to 8 times more invertebrates and fish than do monocultural stands (Engel, 1990). A diverse plant community creates more microhabitats for the preferences of more species.

MANAGEMENT RECOMMENDATIONS

(1) Because the plant cover in the littoral zone of Easton Lake is over the ideal (25%-85%) coverage for balanced fishery, consideration should be given to reducing plant growth in at least some areas. A map of areas to have plants removed should be developed, then removal should occur by hand in shallow areas to be sure that entire plants are removed and to minimize the amount of disturbance to the settlement.

(2) Natural shoreline restoration in some areas is needed. Disturbed shorelines cover too much of the current shoreline, especially with many buildings less than 50' from the ordinary high water mark. A buffer area of native plants should be restored around the lake, especially on those sites that now have traditional lawns mowed to the water's edge or buildings very close to the water's edge. Stormwater management of these impervious surfaces is essential to maintain the high quality of the lake water.

(3) No lawn chemicals, especially lawn chemicals with phosphorus, should be used on properties around the lake. If they must be used, they should be used no closer than 50' to the shore.

(4) An aquatic plant management plan should be developed with a regular schedule of activities. Such plans will be required by the Wisconsin DNR for aquatic plant permits and grants and will also assist in reducing the frequency and density of the plants in Easton Lake. Mechanical harvesting should be used to provide navigation lanes in deeper water.

(5) The schedule should include target harvesting for Eurasian Watermilfoil (EWM) to prevent further spread.

(6) The Easton Lake Association may want to apply for grants from the Wisconsin Department of Natural Resources to help defray the cost of aquatic plant management.

(7) No broad-scale chemical treatments of aquatic plant growth are recommended due to the undesirable side-effects of such treatments, including increased nutrients from decaying plant material and decreased dissolved oxygen and opening up more areas to the invasion of EWM.

(8) Fallen trees should be left at the shoreline.

(9) Although Adams County Land & Water Conservatism Department currently takes regular surface water samples, the program only goes through 2006. Easton Lake residents should continue monitoring through the Wisconsin Self-Help Monitoring Program to permit on-going monitoring of the lake trends for basically no cost.

(10)Easton Lake residents should identify, cooperate with and participate in watershed programs that will reduce nutrient and sediment inputs.

(11) Sensitive vegetation, emergent vegetation and lily pad beds should be protected where they are currently present. These not only provide habitat, but also help stabilize the sandy shores.

(12) The areas where there is undisturbed wooded shore should be maintained and left undisturbed.

(13) The Easton Lake District should make sure that its lake management plan that takes into account all inputs from both the surface and ground watersheds and addresses the concerns of this lake community.

(14)Serious consideration should be given to removing the dam in Easton Lake, allow it to revert to a trout stream. The best use of this stream system appears to be as a trout stream. Removing the dam would accomplish the following:

(a) eliminating most of the nuisance-level vegetation that currently plagues the lake;

(b) eliminating most, if not all, of the floating-leaf and filamentous algae that currently cover most of the lake's surface;

(c) reducing weakly-rooted, cold-water loving *Elodea canadensis;*

(d) distributing some of the sedimentation that currently clogs the far east end of the lake;

(e) restoring the fishery to cold-water fish, such as trout, and reducing the likelihood of stunted panfish that currently occurs;

(f) adding land to those parcels that currently front the lake, since owners would own the land to the middle of the stream, rather than just to the lake shore.

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